United Nations Development Programme

UNDP-TACC Pilot project Uruguay

Territorial Climate Profile

Assessing and mapping climate change vulnerabilities of the Metropolitan Area of Montevideo

Work in Progress-December 2009

Background

❖**Formulation mission** in October 2008

❖**Project document** prepared by Country Office in January 2009 and signed in September 2009

❖ Climate science awareness and **operational training of Uruguay senior technical group** by UNDP/CLIMSAT in Brest in April-May 2009 and initiating the **working scheme** between the Uruguayan unit and ClimSAT in May-June 2009

❖Sharing data inventories and **methods** for the **biophysical vulnerability assessment and mapping** since June-July 2009

❖Reorganization of the Uruguayan unit including adaptation and mitigation sub unit in the **'Unidad del Cambio Climatico"** in August 2009

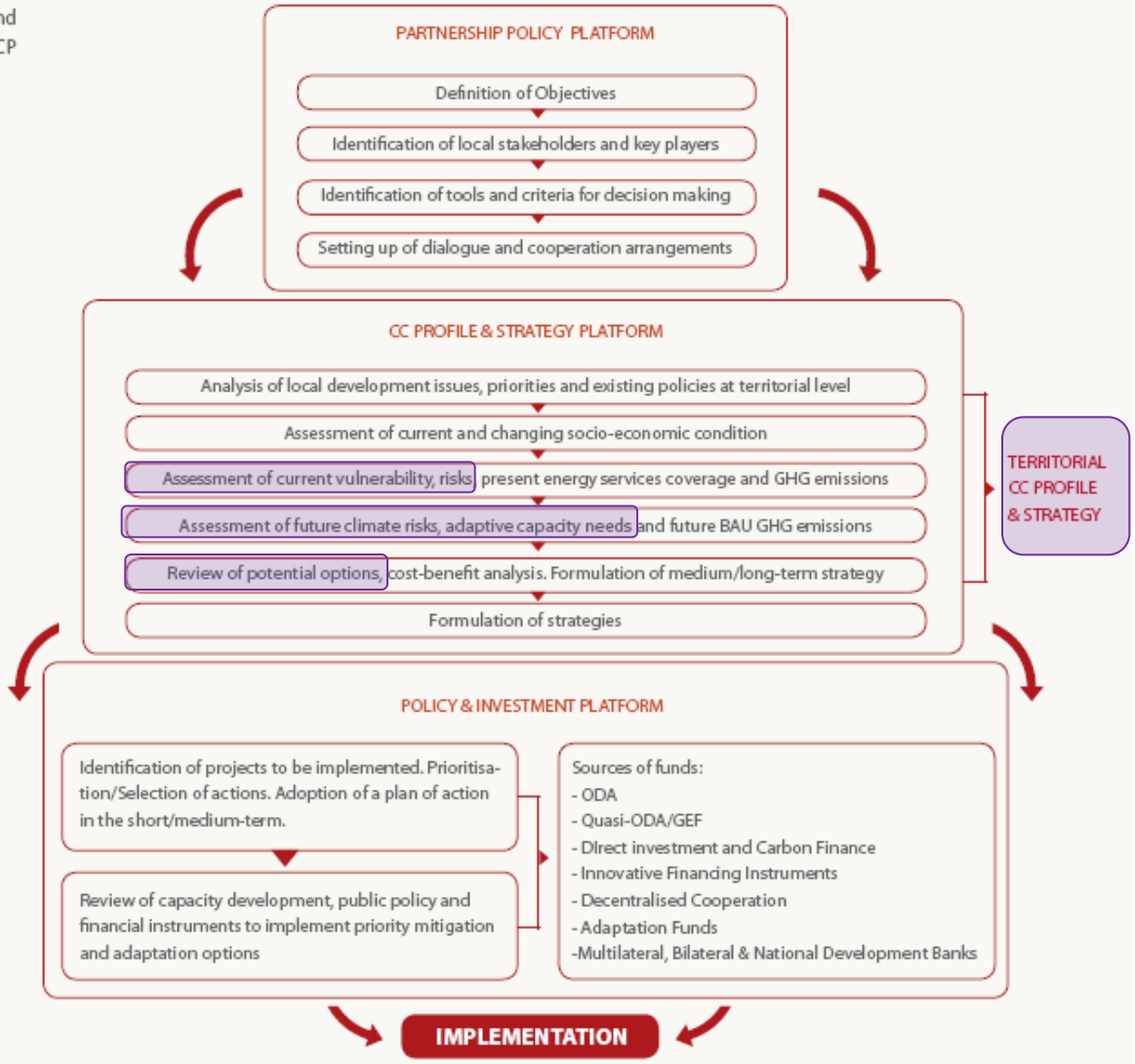
❖Official launch of the **Montevideo ITCP co-construction process** in September 2009

❖Gathering and processing various existing on-site and satellite **data, for exposure and sensitivity analysis** since August 2009

❖**Prospective high resolution climate scenarios** since October-November 2009

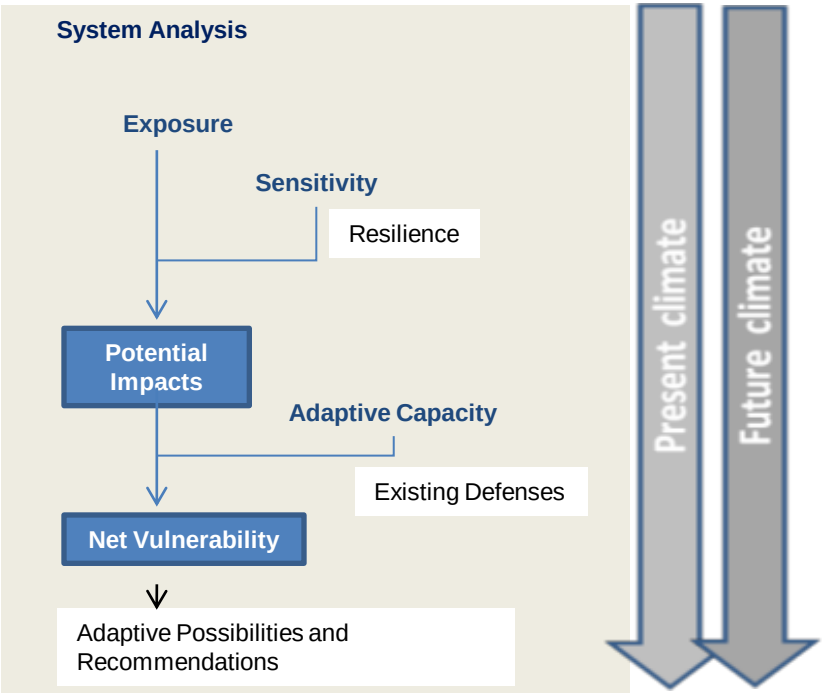
Integration in the ITCP development process

Figure 1: Methodologies and Process for Developing an ITCP



Conceptual and methodological framework for assessment and mapping of climate change vulnerabilities

Methodological framework



Vulnerability= (exposure* sensitivity)* adaptive capacity

Exposure assessment
-exposure inventory of the impacted systems

Sensitivity assessment and mapping
- the resistance of the exposed system: the location, the degree, the mechanisms at stake

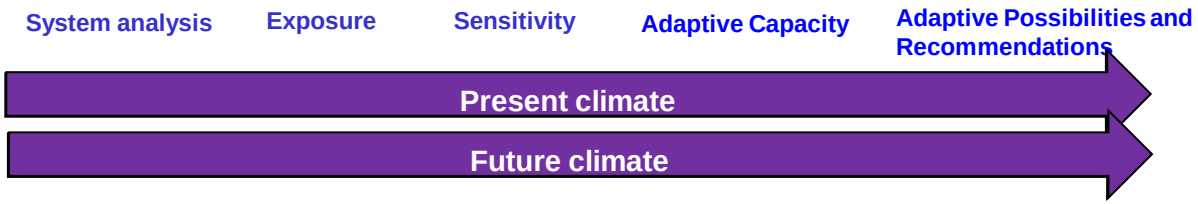
Adaptive capacity assessment and mapping
-existing defences, coping mechanisms: the location, the degree of efficiency, the potential mobilization

Vulnerability assessment and mapping
-synthesized indicators of the vulnerable systems: the location, the frequency, the degree of vulnerability

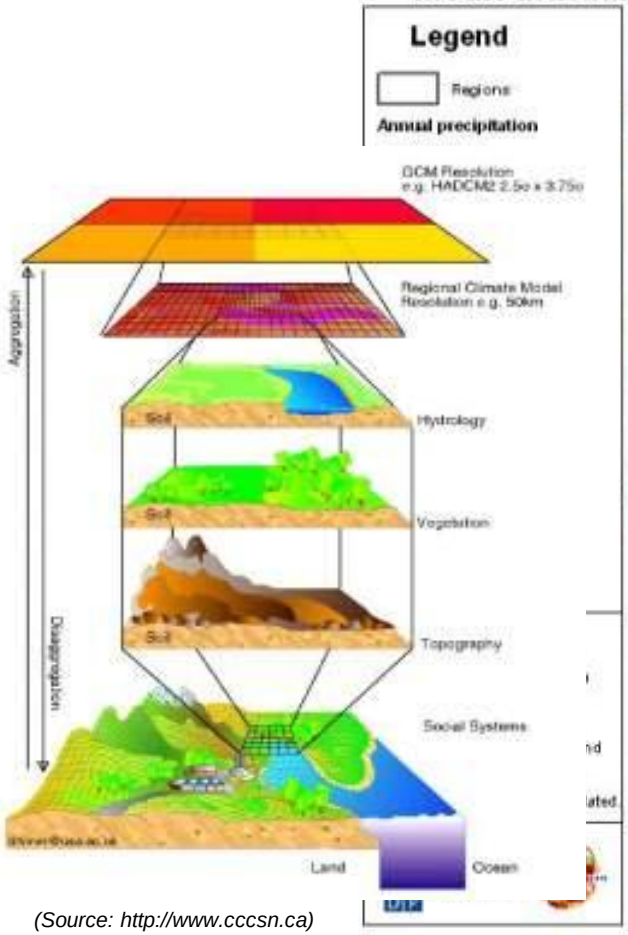
Assessing climate change vulnerabilities :Step 1

Prospective climatology on the metropolitan area of Montevideo, Uruguay

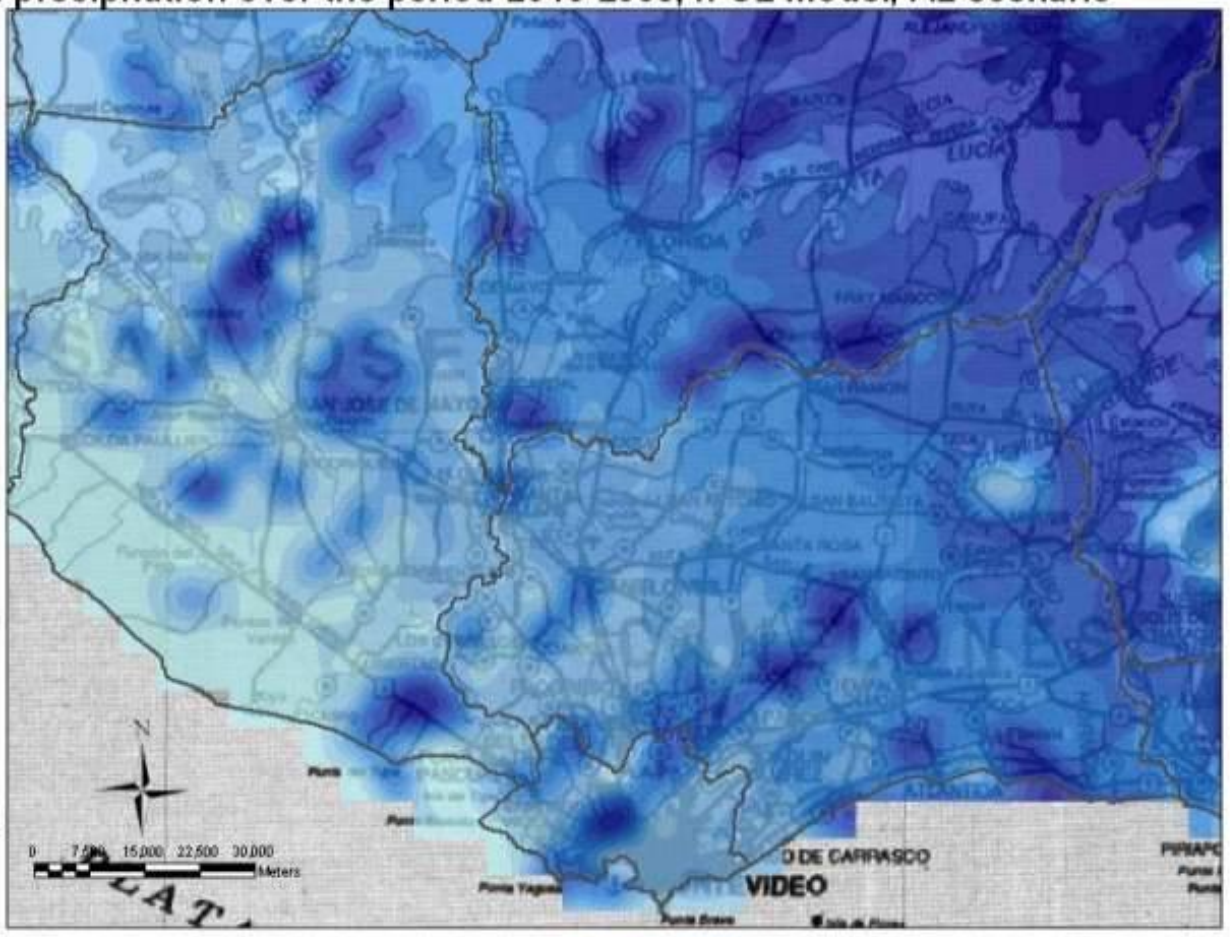
Downscaled climatic present and future data according to 2 IPCC scenarios and 2 models



Downscaling methodology on climatic data

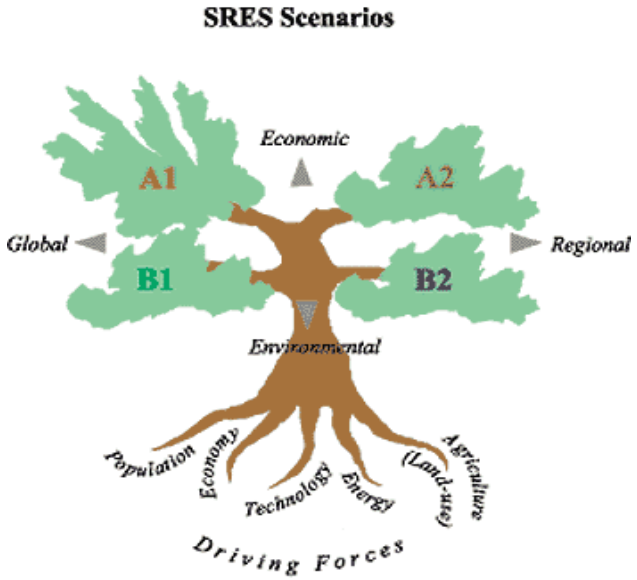


(Source: http://www.cccsn.ca)



Smoothing of the downscaled data by interpolation

Prospective climatology on the Metropolitan area of Montevideo



(Source : Nakicenovic, N. et al (2000). Special Report on Emissions Scenarios: A Special Report of Working Group III of the IPCC)

Mean annual precipitation over three periods

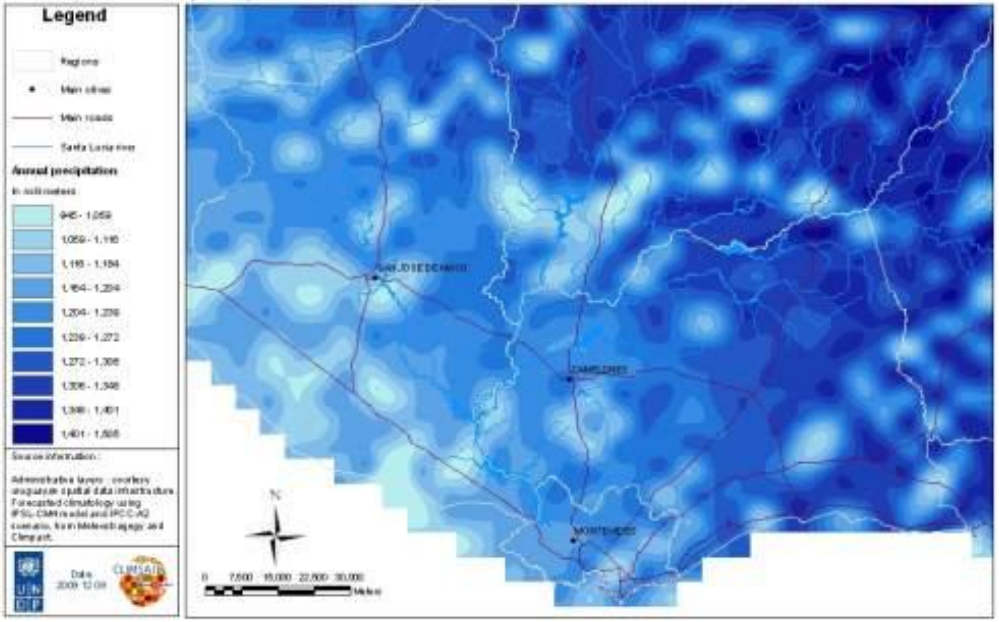
IPCC SRES A2 (business-as-usual-attitude assumption)	**IPCC SRES B1** (global cooperation towards environmentally sustainable development)

Prospective climatology on the Metropolitan area of Montevideo

Mean annual precipitation over three periods with IPSL-CM4 model

IPCC SRES A2 (business-as-usual-attitude assumption)

Mean annual precipitation over the period 2081-2100, IPSL model, A2 scenario



- Behaviours at the end of the 21st century (both periods)

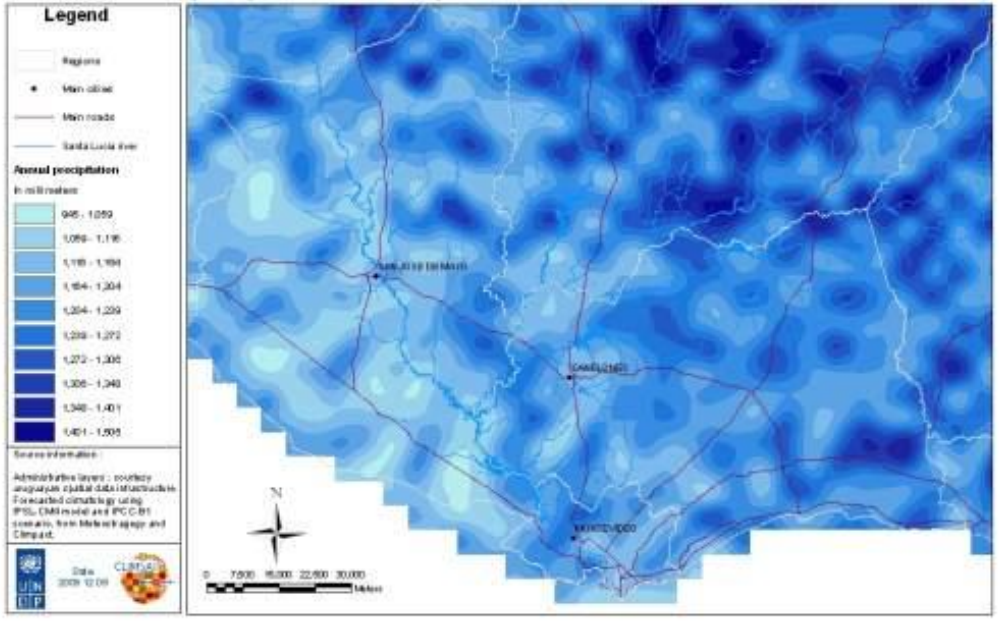
IPSL →Overall increase (+2.6%) with local decreases
But **less precipitation in 2081-2100 than in 2046-2065**

- Maximum local changes (%) in 2081-2100

IPSL →+13% , -21.5%

IPCC SRES B1 (global cooperation towards environmentally sustainable development)

Mean annual precipitation over the period 2081-2100, IPSL model, B1 scenario



- Behaviours at the end of the 21st century (both periods)

IPSL → Overall stagnation with a little tendency to decrease (-0.4% with local decreases and increases)
But **less precipitation in 2081-2100 than in 2046-2065**

- Maximum local changes (%) in 2081-2100
  - IPSL →+26.6% , -9.2%

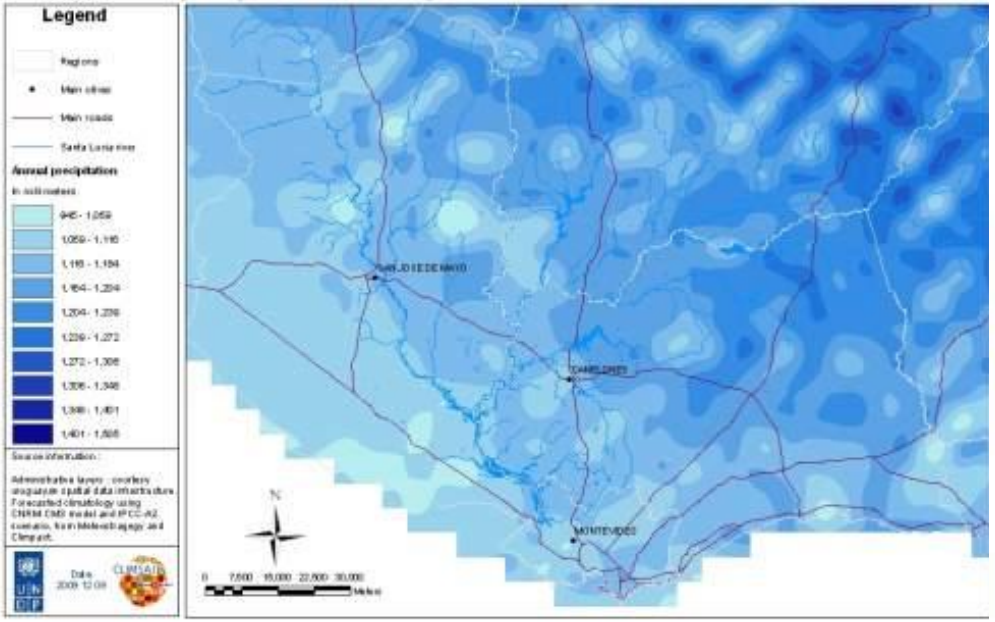
Prospective climatology on the metropolitan area of Montevideo

Mean annual precipitation over three periods with CNRM-CM 3 model

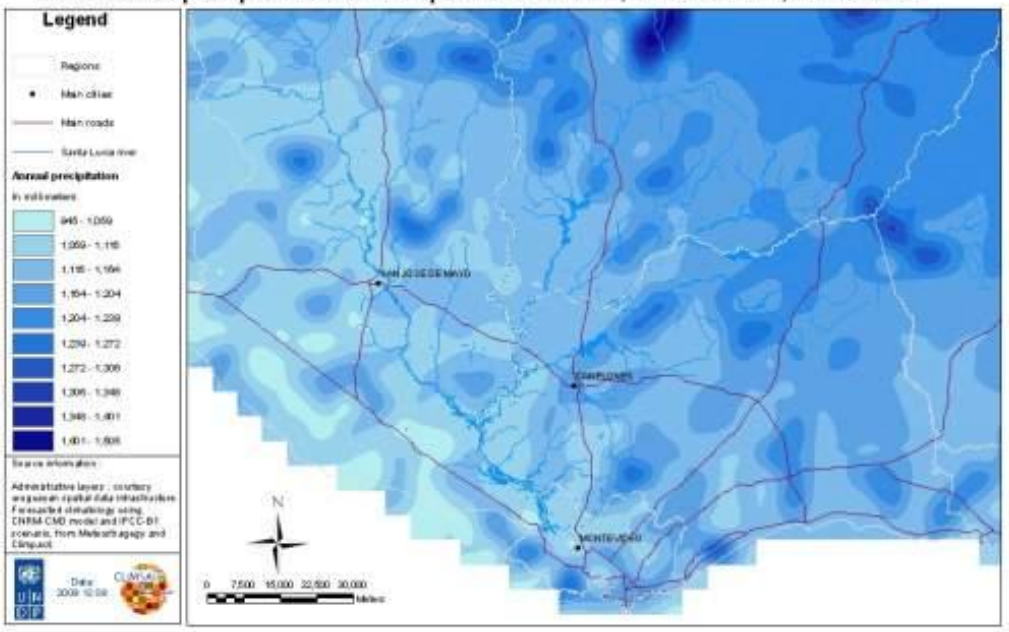
IPCC SRES A2 (business-as-usual-attitude assumption)

IPCC SRES B1 (global cooperation towards environmentally sustainable development)

Mean annual precipitation over the period 2081-2100, CNRM model, A2 scenario



Mean annual precipitation over the period 2081-2100, CNRM model, B1 scenario



- Behaviours at the end of the 21st century (both periods)

CNRM →Overall decrease (-4.4%)
But **less precipitation in 2081-2100 than in 2046-2065**

- Maximum local changes (%) in 2081-2100

CNRM → +3.2%, -23.5%

- Behaviours at the end of the 21st century (both periods)

CNRM → Overall decrease (-4.2%)
But **less precipitation in 2081-2100 than in 2046-2065**

- Maximum local changes (%) in 2081-2100

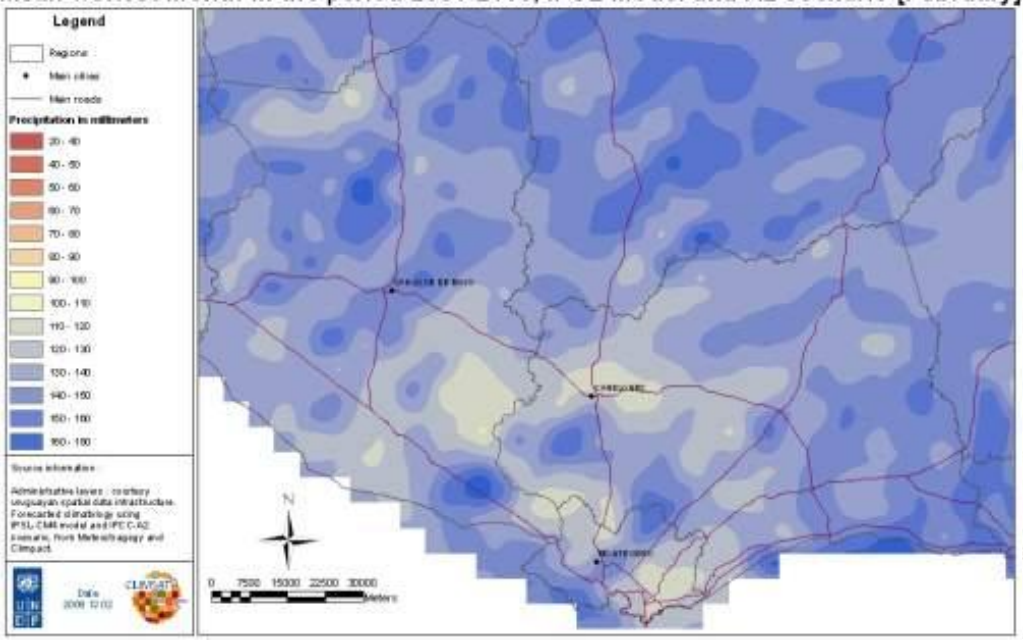
CNRM → +25.8%, -14.5%

Prospective climatology on the metropolitan area of Montevideo

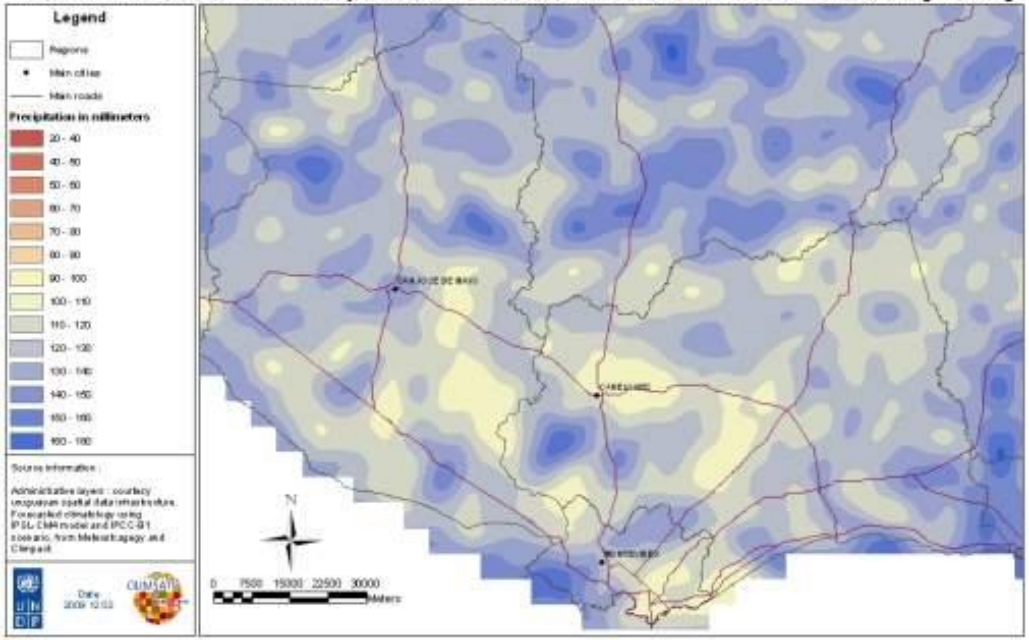
Mean driest month precipitation over three periods followed by mean wettest month precipitation with IPSL-CM4 model

IPCC SRES A2 (business-as-usual-attitude assumption)	**IPCC SRES B1** (global cooperation towards environmentally sustainable development)

Mean wettest month in the period 2081-2100, IPSL model and A2 scenario [February]



Mean wettest month in the period 2081-2100, IPSL model and B1 scenario [March]



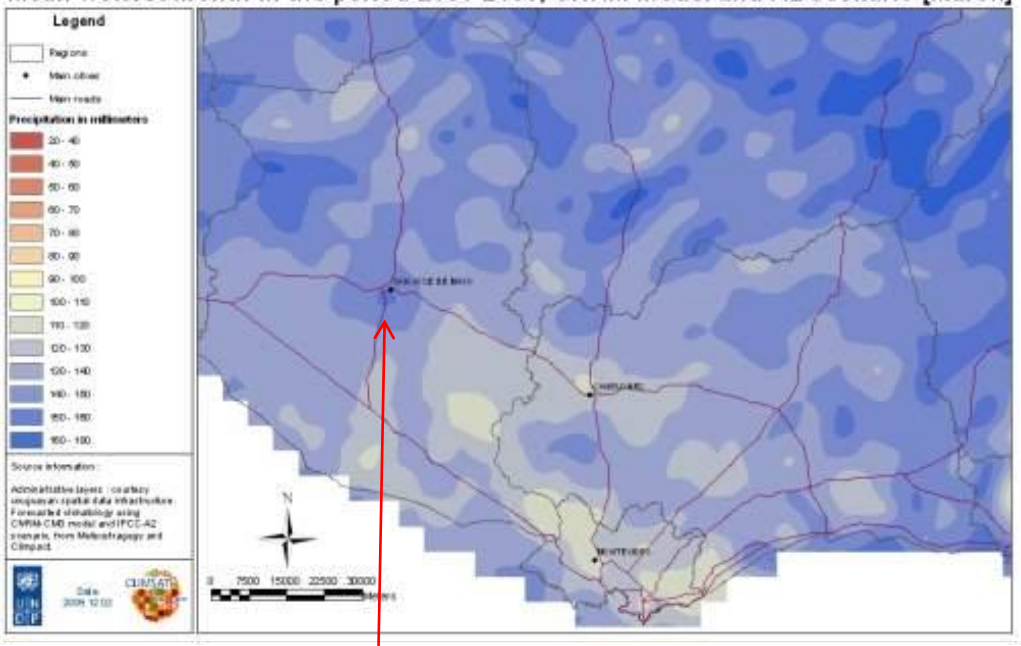
Prospective climatology on the metropolitan area of Montevideo

Mean driest month precipitation over three periods followed by mean wettest month precipitation with CNRM-CM 3 model

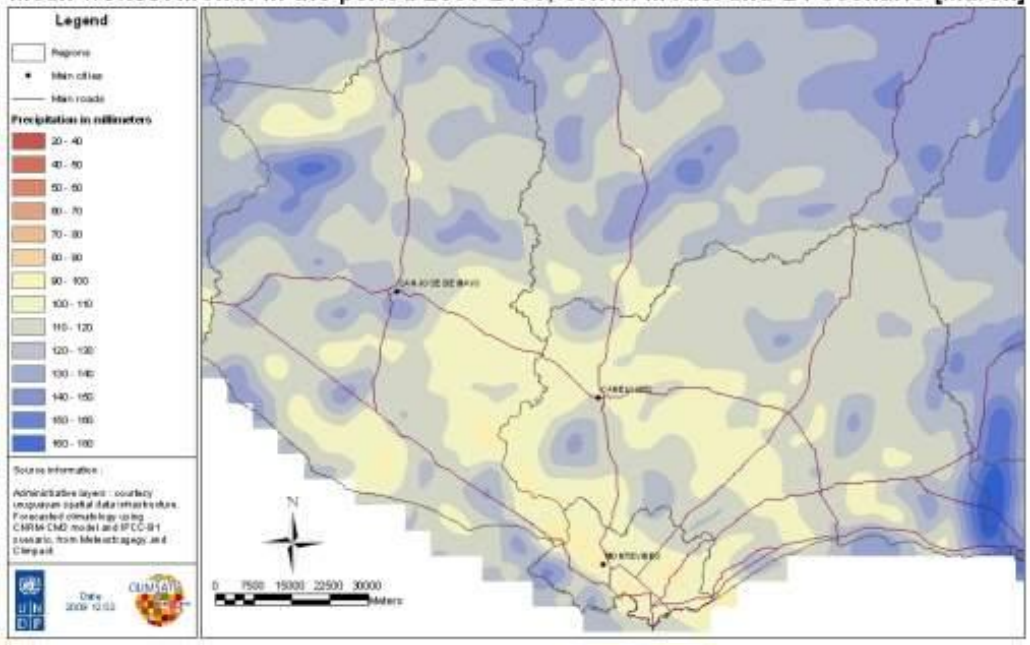
IPCC SRES A2 (business-as-usual-attitude assumption)

IPCC SRES B1 (global cooperation towards environmentally sustainable development)

Mean wettest month in the period 2081-2100, CNRM model and A2 scenario [March]

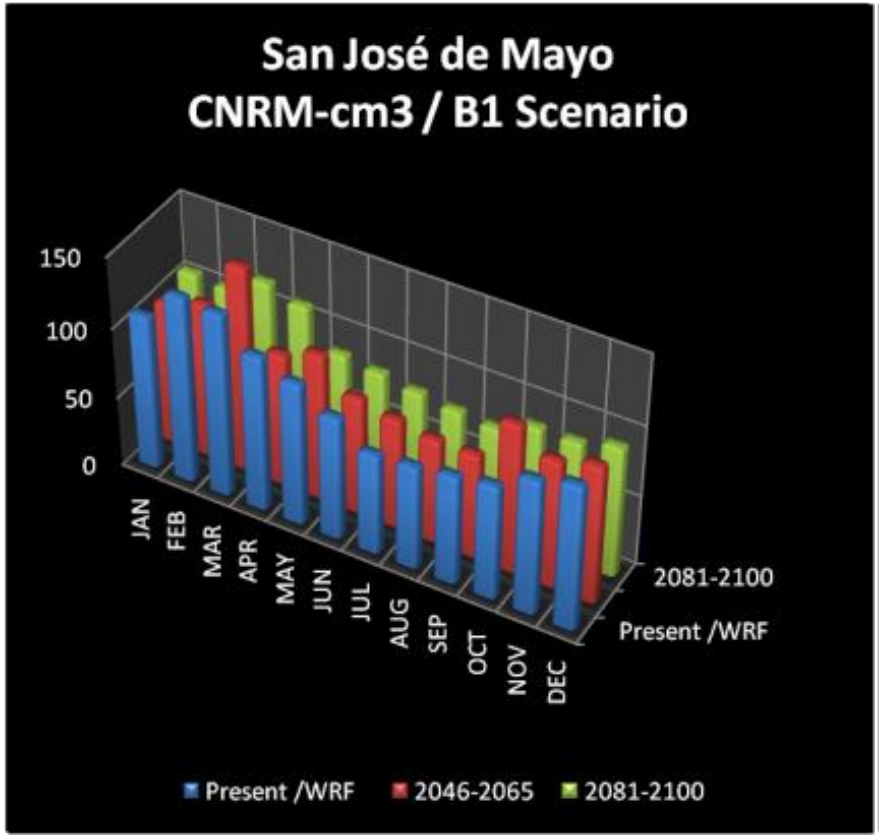


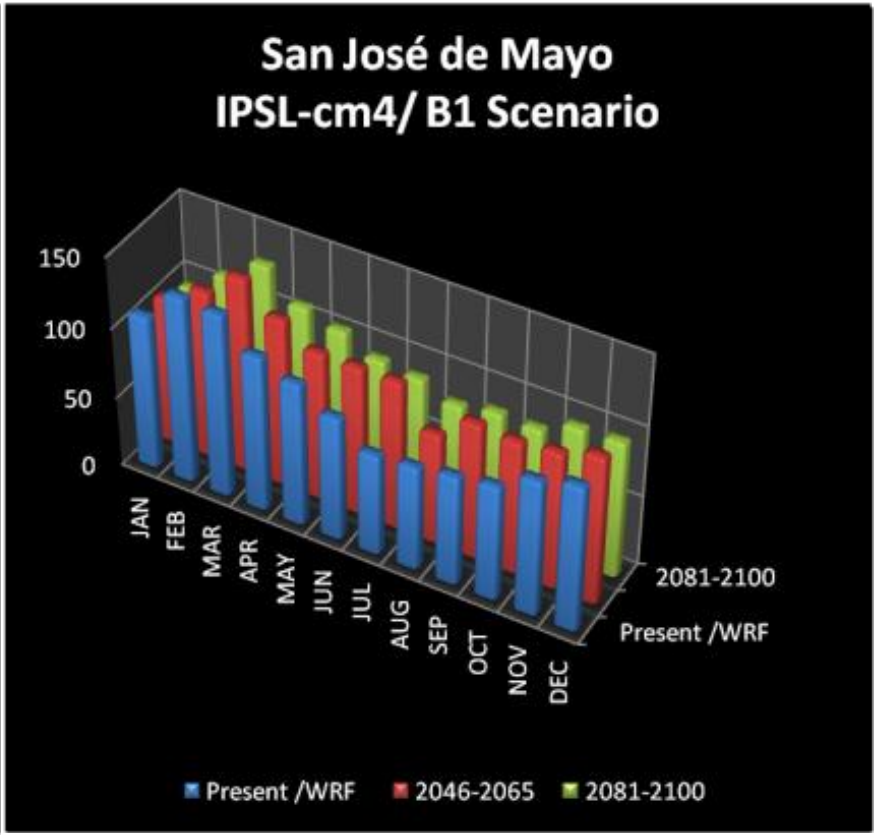
Mean wettest month in the period 2081-2100, CNRM model and B1 scenario [March]



See San Jose precipitation profile

Prospective climatology on the metropolitan area of Montevideo, Uruguay

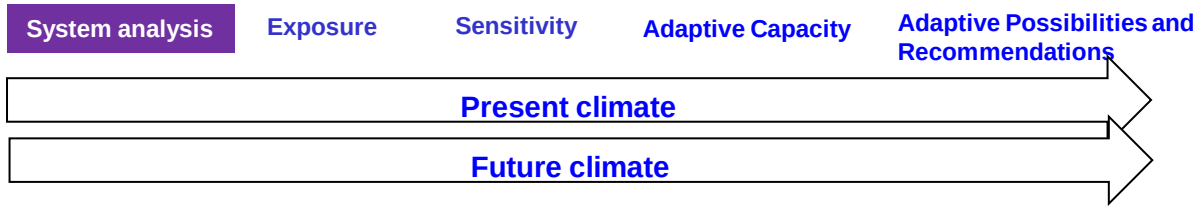




In A2 scenario, by 2100, climate will be slightly drier but higher seasonal variation, with a marked delay in the rainfall peak (1 to 2 months) compared to present and heavier spring precipitations.
In B1 scenario, by 2100, decreasing rainfall is less marked, with a lower seasonal variation and less delay in the rainfall peak compared to present, although by 2050 rainfall follows a pattern similar to A2 scenario.

Assessing climate change vulnerabilities : Step 2

System analysis of critical water resources for the metropolitan area of Montevideo



Assessing climate change vulnerabilities : Step 2

System analysis of critical water resources for the metropolitan area of Montevideo

60% of the total population of Uruguay (3.5 millions) live in the metropolitan area of Montevideo.
In this territory, nearly **100%** of the population drinking water needs are supplied from **a single pumping station located in the Santa Lucia river**.
Water resources and uses appear to be threatened both in terms of **quality** (contaminants and saltwater) and **quantity** (floods and droughts conducing to shortages of water supply).

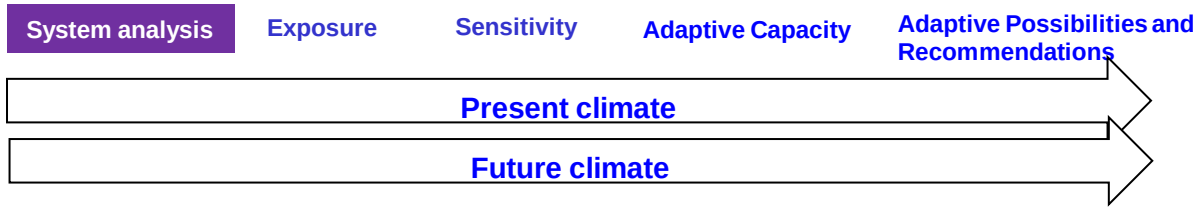
Water related territorial systems at climate change risk :

- Very urbanized densely populated coastal zone,
- Highly sensitive ecosystems (wetlands and riparian forests),
- Complex and instable hydrographic networks,
- High concentration of intensive agriculture (agrochemicals, irrigation)
- Highly exposed fish stocks,
- Sensitive hydropower infrastructures (sedimentation, instable supply).

Assessing climate change vulnerabilities : Step 2

System analysis of critical water resources for the metropolitan area of Montevideo

Understanding the hydrological context



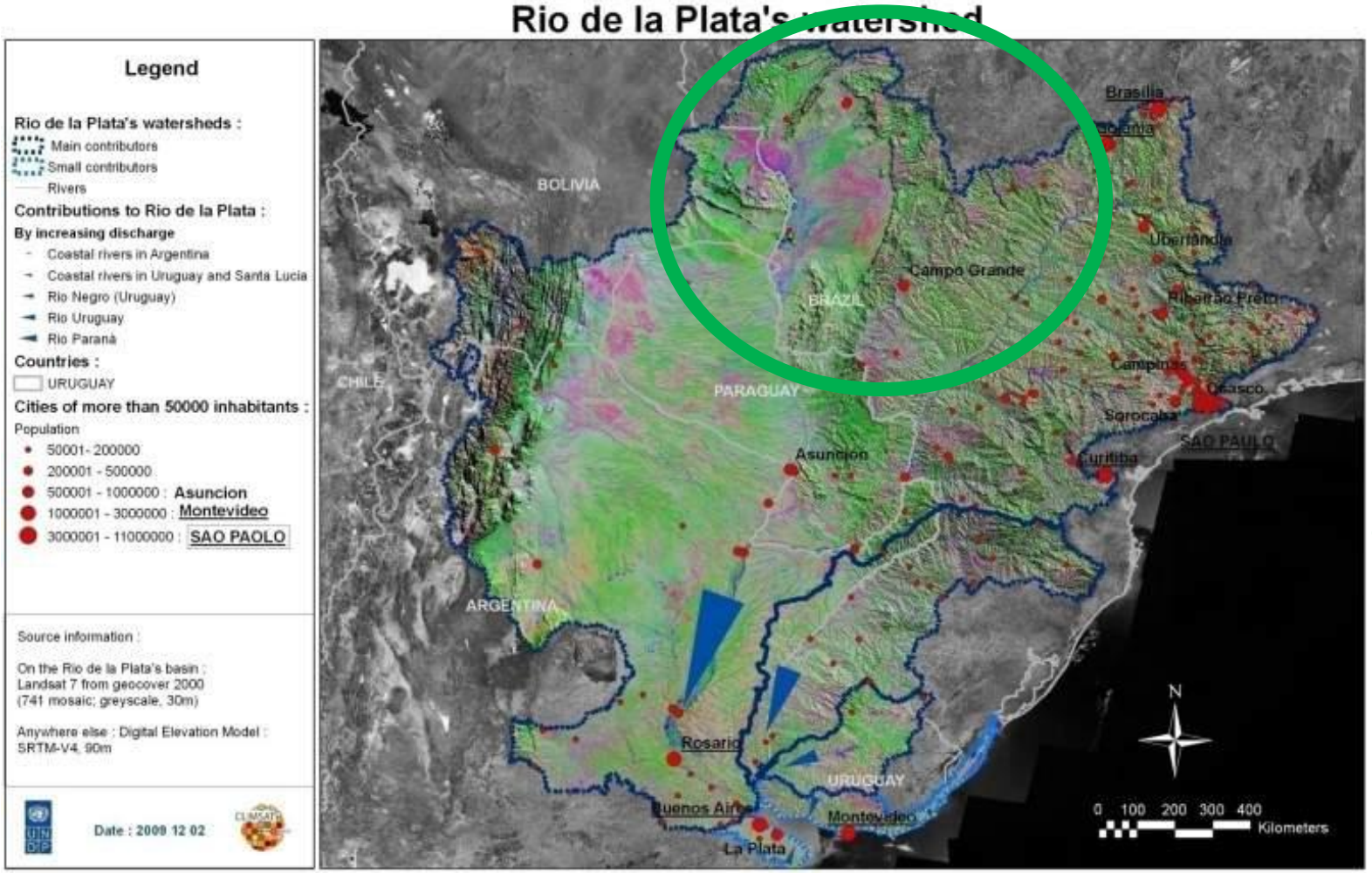
Assessing climate change vulnerabilities : Step 2

Important risk of land degradation

The immense estuary of the **Rio de la Plata** is the mouth of the Uruguay and Parana rivers.
250 km long and always less than 10 m deep, it is the frontier between Argentina and Uruguay.
Furthermore, navigation channels have to be maintained all the time because the river carries more than **57 millions of m^3 of sediments every year**.
Indeed the **3 millions km^2 collecting basin** covers an important part of South America (for reference, the Congo Basin is 1.8 millions km^2).

The **Santa Lucia** watershed is part of the Rio de la Plata watershed and supplies nearly 100 % of the metropolitan area water requirements.
Besides, the **single water pumping station** is located 50 miles northwards to the Rio de la Plata estuary.

Assessing climate change vulnerabilities : Step 2



Important risk of land degradation

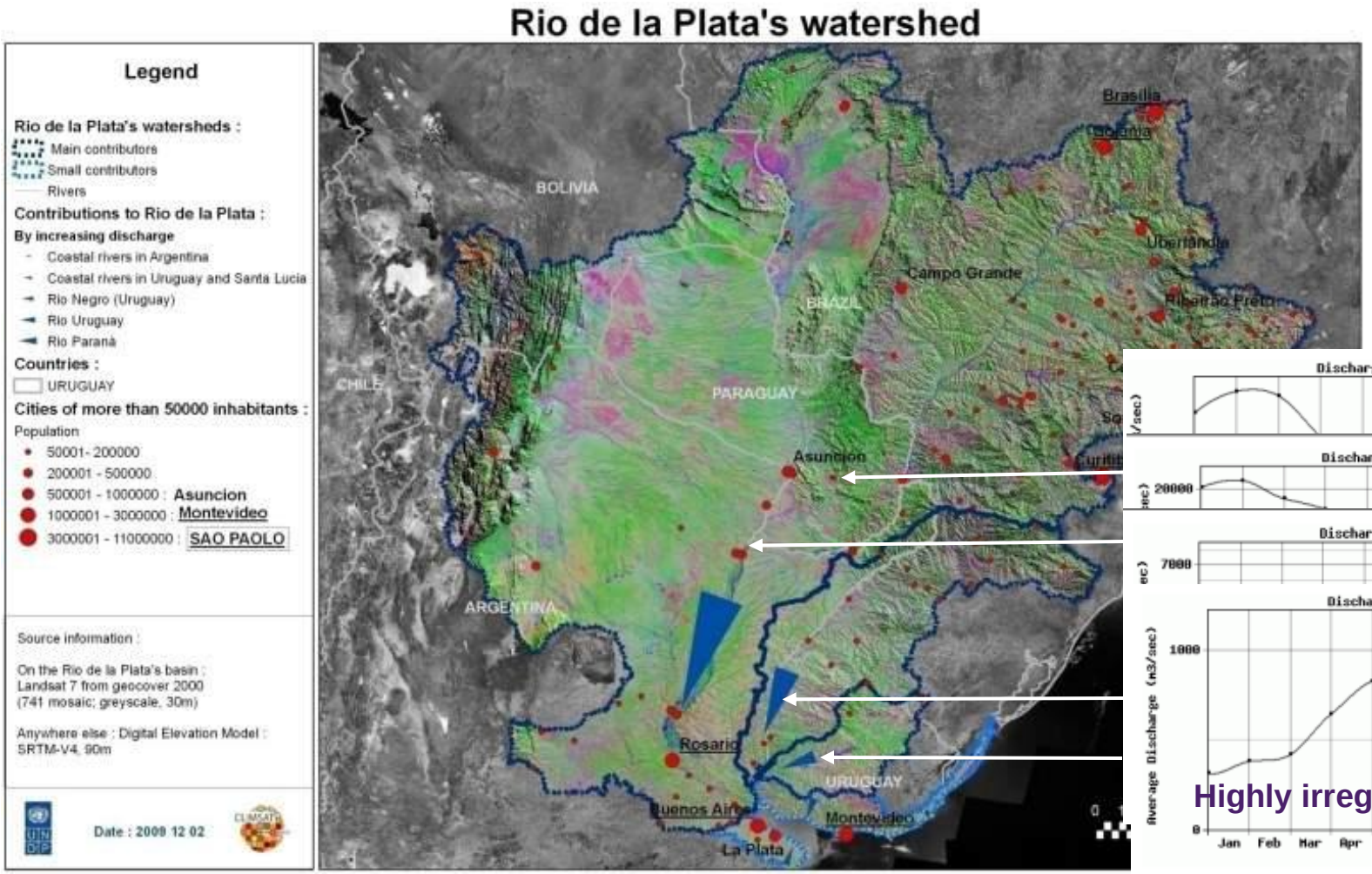
High seasonal variation of river discharges

Different times of concentration

In Mato Grosso, high level of deforestation and erosion due to rapid agro fuel and cattle development

=> Increasing volume of sediments incoming Rio de la Plata system in the future

Assessing climate change vulnerabilities : Step 2



Important risk of land degradation

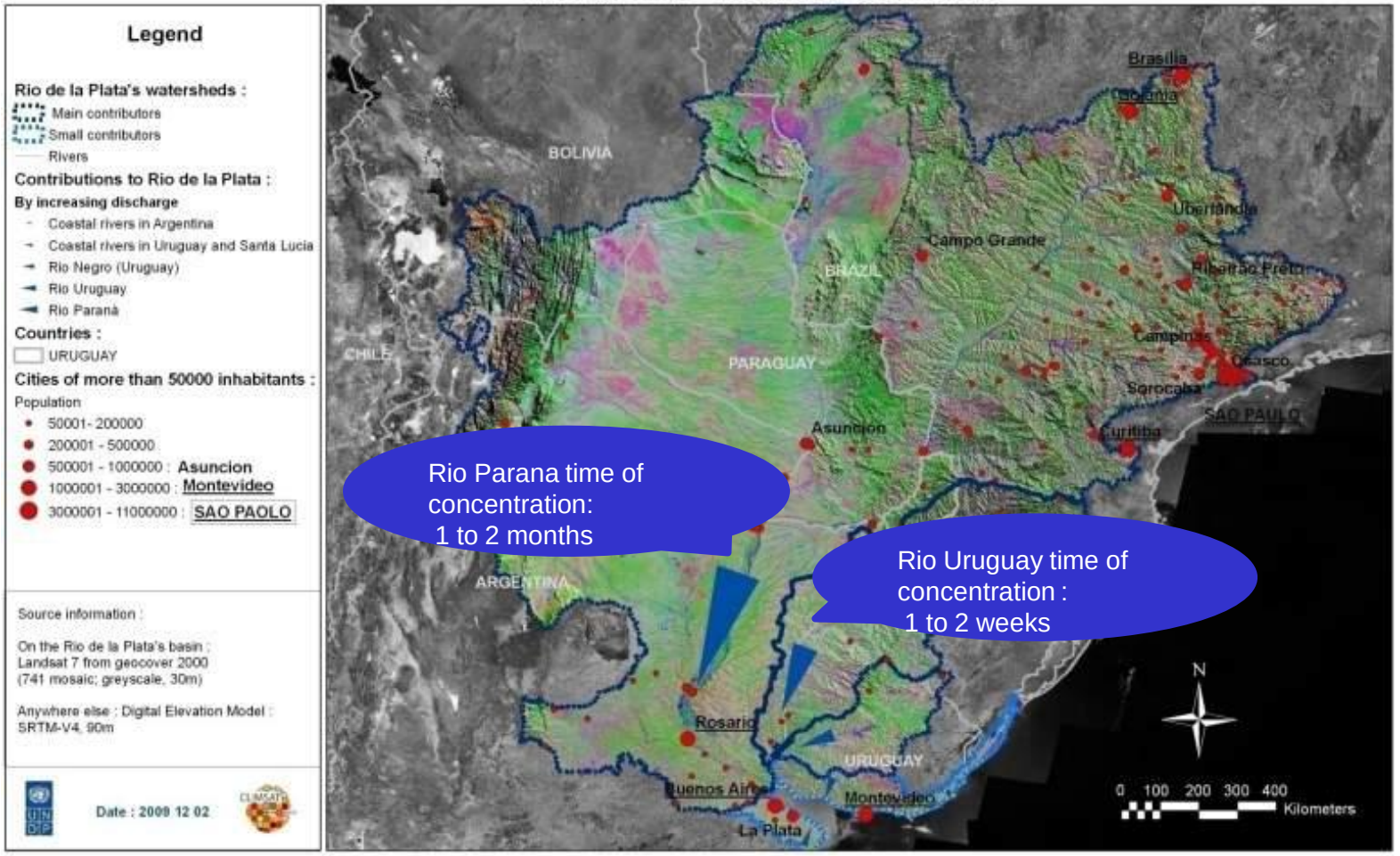
High seasonal variation of river discharges

Different times of

Highly irregular seasonal regime

Assessing climate change vulnerabilities : Step 2

Rio de la Plata's watershed



Important risk of land degradation

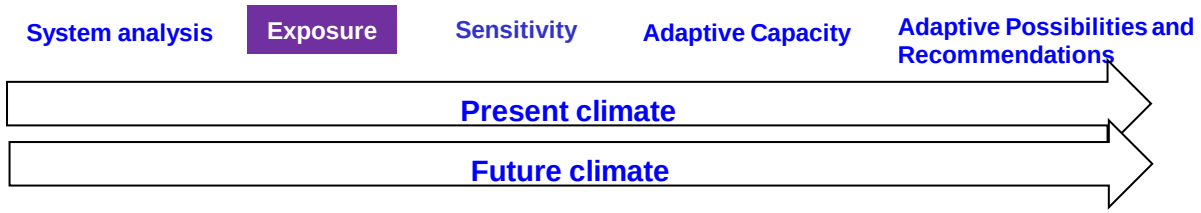
High seasonal variation of river discharges

Different times of concentration

Probability of Cumulative Large scale floods

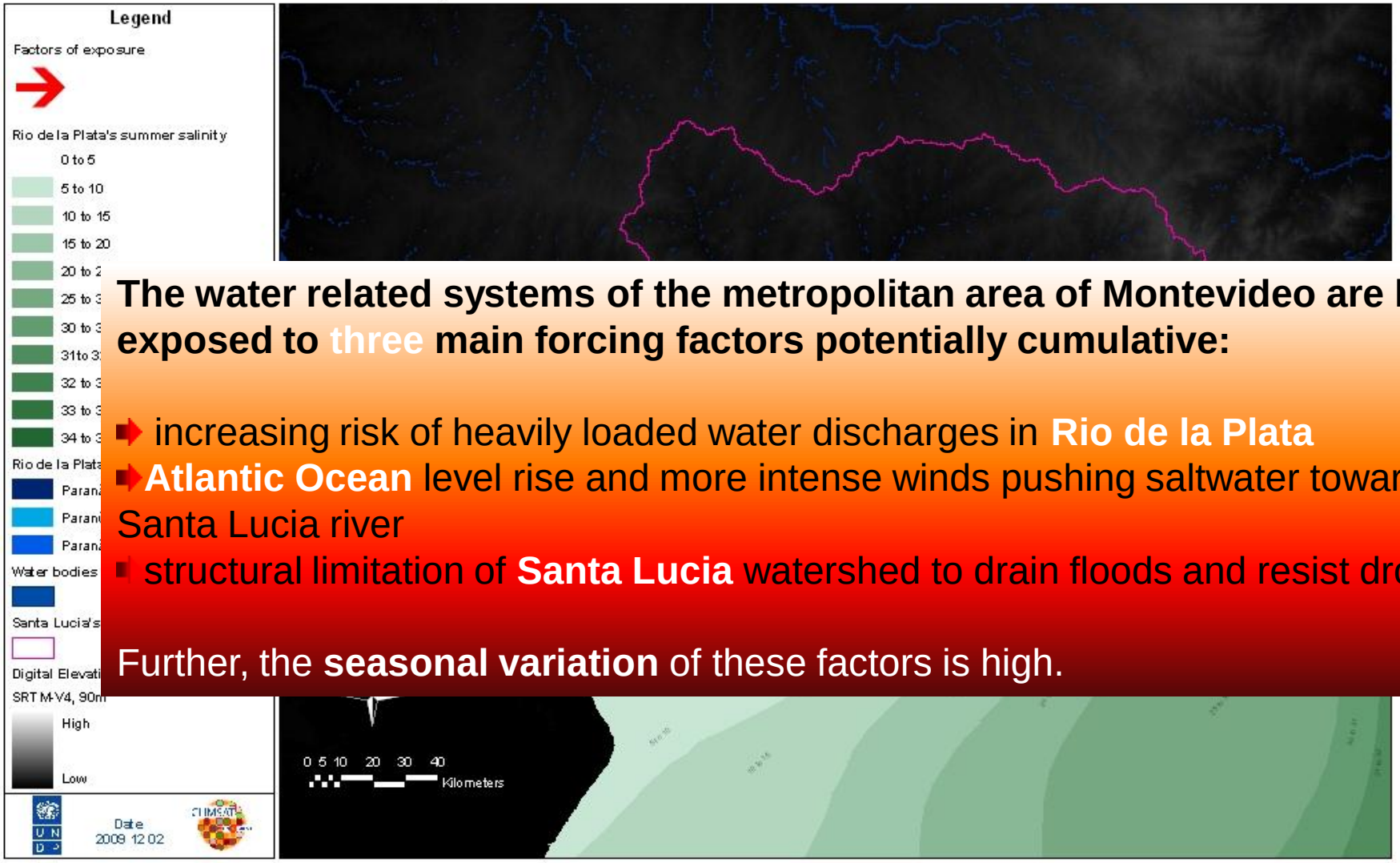
Assessing climate change vulnerabilities : Step 3

Seasonal exposure of water resources and water uses of the metropolitan area of Montevideo



Assessing climate change vulnerabilities : Step 3

Exposure of Santa Lucia river in summer



The water related systems of the metropolitan area of Montevideo are highly exposed to three main forcing factors potentially cumulative:

- increasing risk of heavily loaded water discharges in **Rio de la Plata**
- **Atlantic Ocean** level rise and more intense winds pushing saltwater towards Santa Lucia river
- structural limitation of **Santa Lucia** watershed to drain floods and resist droughts

Further, the **seasonal variation** of these factors is high.

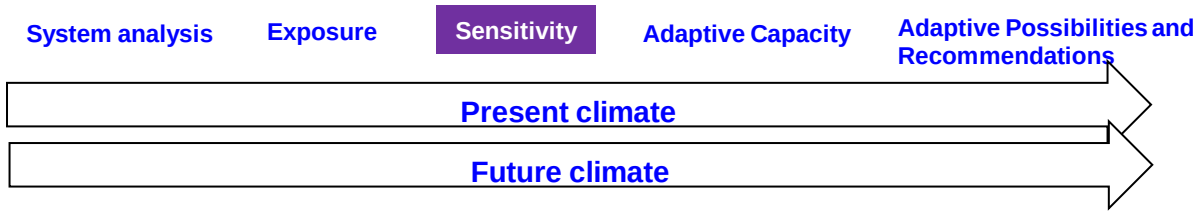
Assessing climate change vulnerabilities : Step 3

Exposure of Santa Lucia river in winter

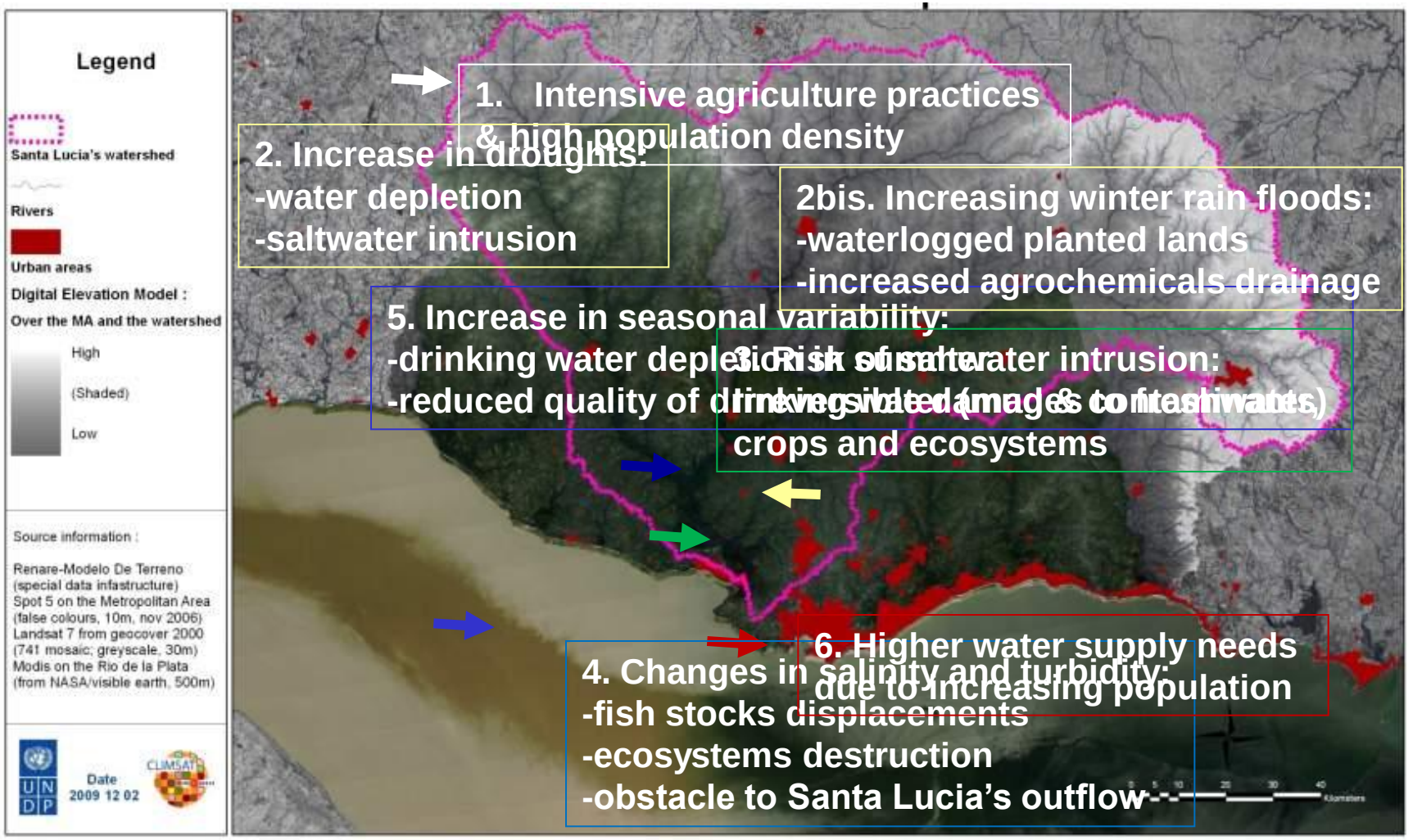
Event	Date	Victims
Flood	05/04/2007	119,200
Flood	june-01	5,000
Flood	05/16/2000	5,000
Flood	04/11/1998	9,300
Flood	august-86	18,500
Flood	1967	38,063

Assessing climate change vulnerabilities : Step 4

Sensitivity of water resources and uses to climate change

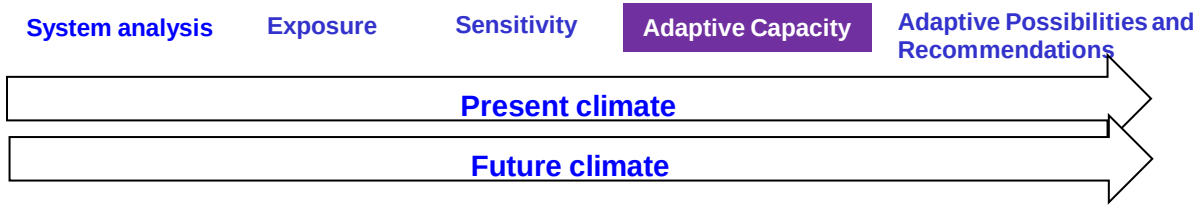


Assessing climate change vulnerabilities : Step 4



Assessing climate change vulnerabilities : Step 5

Adaptive capacities



Assessing climate change vulnerabilities : Step 5

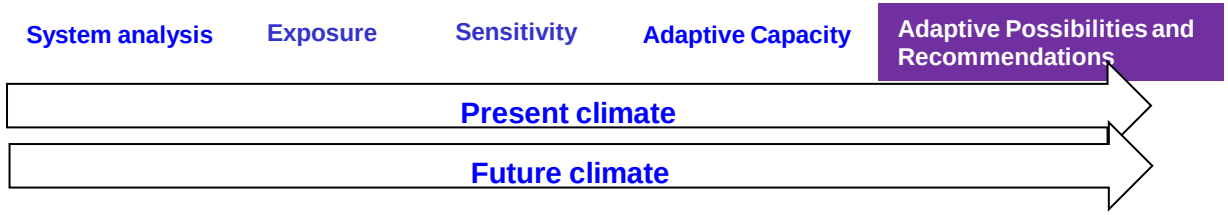
Adaptive capacities

- High **urban planning** capacity
- Well **managed agricultural** sector open to innovation
- High **scientific level** in hydrological sciences
- Well organized **disaster response** mechanisms

HDI superior to 0.8, 40th on 173 in the world list
Early engagement in UNFCCC and Kyoto Protocol, pioneer in Latin America

Assessing climate change vulnerabilities : Step 6

Adaptive strategies to manage water resources and uses in a changing climate



Assessing climate change vulnerabilities : Step 5